



Rigs of Rods

Science Day
c-base

Thomas Fischer



Motivation

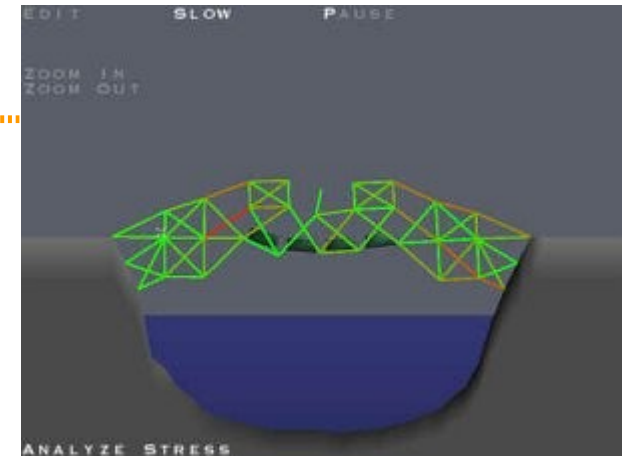
- No major improvement in physics engine of racing simulations:
 - Indianapolis 500 (Papyrus) 1989
 - Carmageddon (Stainless) 1997
 - Grand Prix Legend (Papyrus) 1998
 - « *one of the most realistic racing games ever released* »
- Most current titles are not realistic and are often worse
 - « arcade » Simulations:
 - Drifting, Live for Speed, etc.
 - Model chewing gum (GTA4)





Inspirations

- Pontifex/Bridge Builder (Chronic Logic) 2000
 - Physical model
- 1nsane (Codemasters) 2001
 - All-terrain freedom
 - Deformable chassis
- Grand Theft Auto III (Rockstar) 2001
 - Total immersion: the logic of the game is the focus
- Hard Truck 2 (softlab-NSK) 2002
 - Nice models but worse physics
 - Mixture of economic simulation and driving



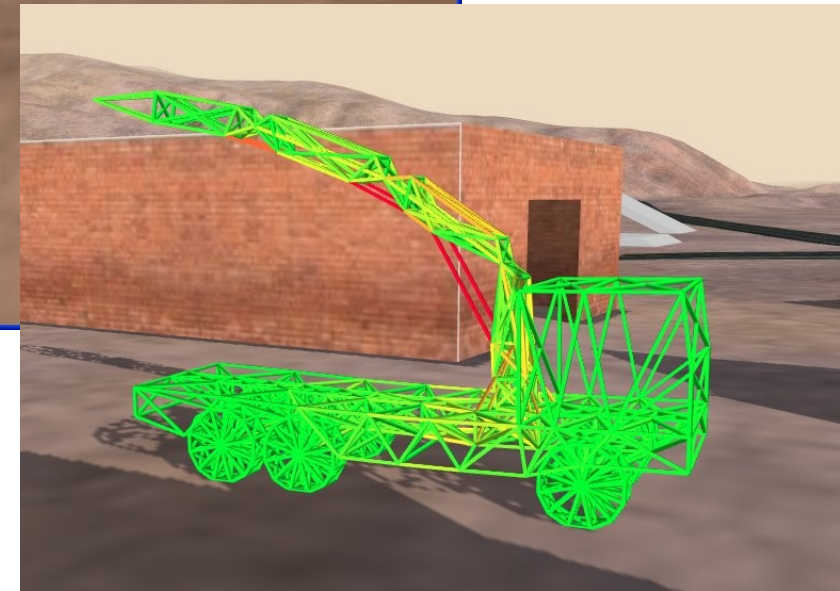


Idea

- « Pontifex on wheels »



- Very encouraging early results





History

- March 2005 : First experiments by Pierre-Michel
- August 2005 : First public version
- August 2006 : Flight model added
- November 2006 : Linux Port
- February 2007 : Flotation model added (boats)
- April 2007 : Creation of the official forum, the first test network play
- August 2007 : Thomas Fischer joined the team
- January 2008 : MacOS X Port
- February 2009 : Code released under GPLv3



Game Overview



<http://www.youtube.com/watch?v=1y3ksYbf2uE>



Physical model

- Very simple model (school level)
- Set of nodes of mass m (node)

- Newtons law of motion

$$\vec{a} = \frac{1}{m} \sum \vec{F}_i$$

- Euler integration

$$a = \frac{dv}{dt} \quad v = \frac{dx}{dt}$$

- Dimensionless point: no time

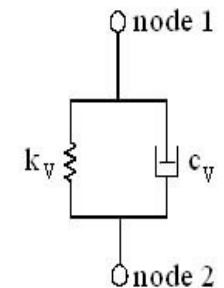
- Connected by springs (beam)

- Spring

$$F_s = -kx$$

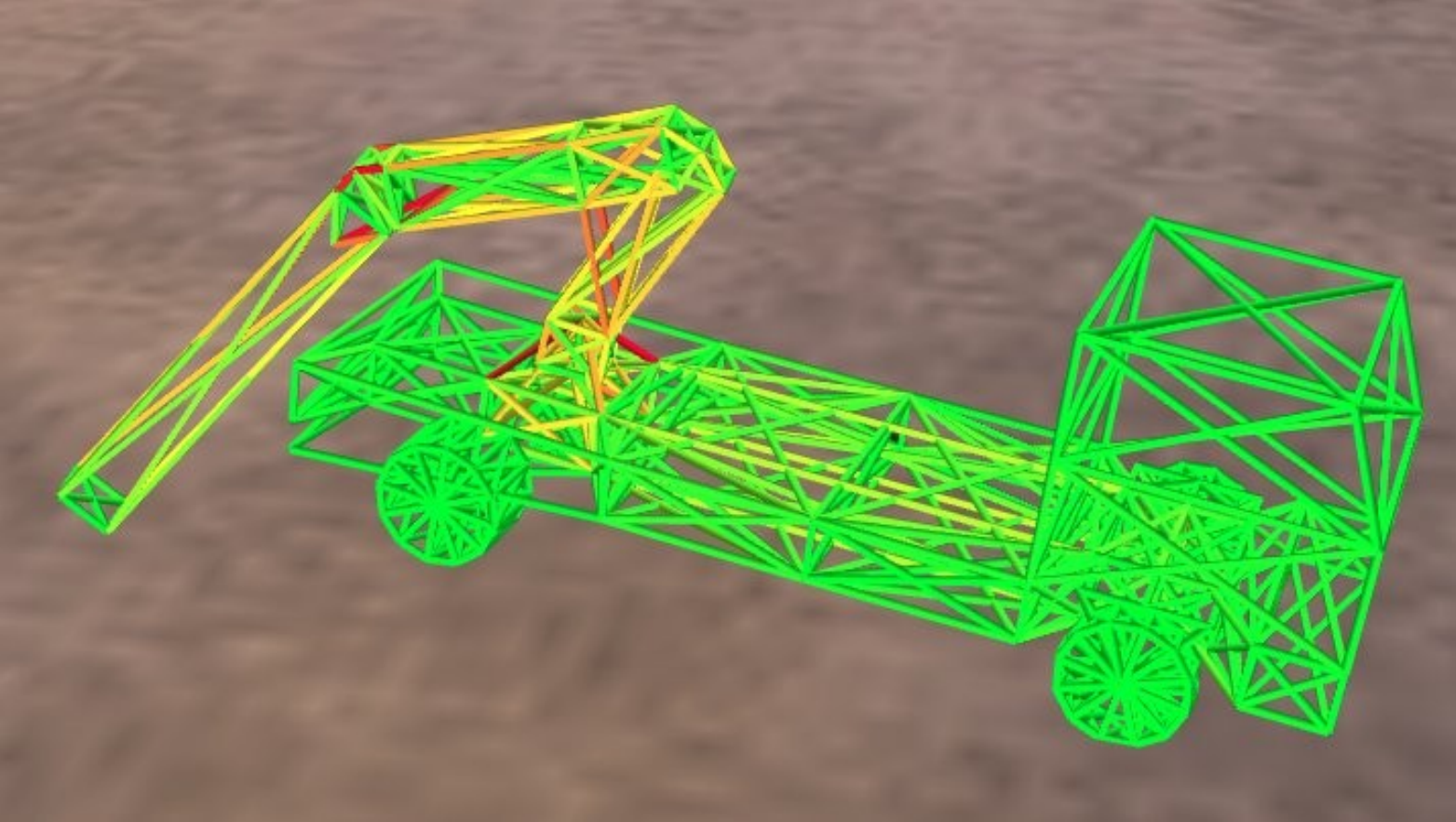
- Shocks

$$F_d = -cv = -c\dot{x} = -c\frac{dx}{dt}$$






Model Properties



- The nodes are links with ball joints: Requires triangularisation
- Forces propagate through the network of bars
- You can apply arbitrary forces on any node



Model Advantage

- No law on the rigid body is explicitly in the code
 - No matrices of inertia, no times or speeds
 - No center of gravity
- In practice, we observe that the assembly behave as rigid bodies 
<http://www.youtube.com/watch?v=no3S6hllMrg>
 - The physical laws of rigid body interactions emerge from node bar simulation
- Simple modeling of damage
 - Plastic deformation and breakage of the bars



Drawbacks of the model

- Requires much more calculations than classical physics engines
 - Single chassis with 4 wheels: 200 knots, 1,000 bars
 - The bars are very rigid: the integration is unstable if the calculation takes not too long (dt). This is not fixed at 1/2.000 second.
 - A single chassis requires the processing of 400,000 nodes / s and 2,000,000 bars / s
- Only a Pentium 4 or later can achieve this performance, with specific optimizations



Contact/Friction

- Collision detection
 - Very fast! (nominally 400,000 inquiries / s)
 - Based on spatial hash tables
- Responding to collisions
 - Reaction force and the conservation movement
 - Friction: Stribeck model (elastohydrodynamic model)
 - Local model of the rubber tire: much more powerful than the global models of the wheel (Pacejka)
 - Different models of land



Contact/Friction



<http://www.youtube.com/watch?v=Oug7XaLNXq8>



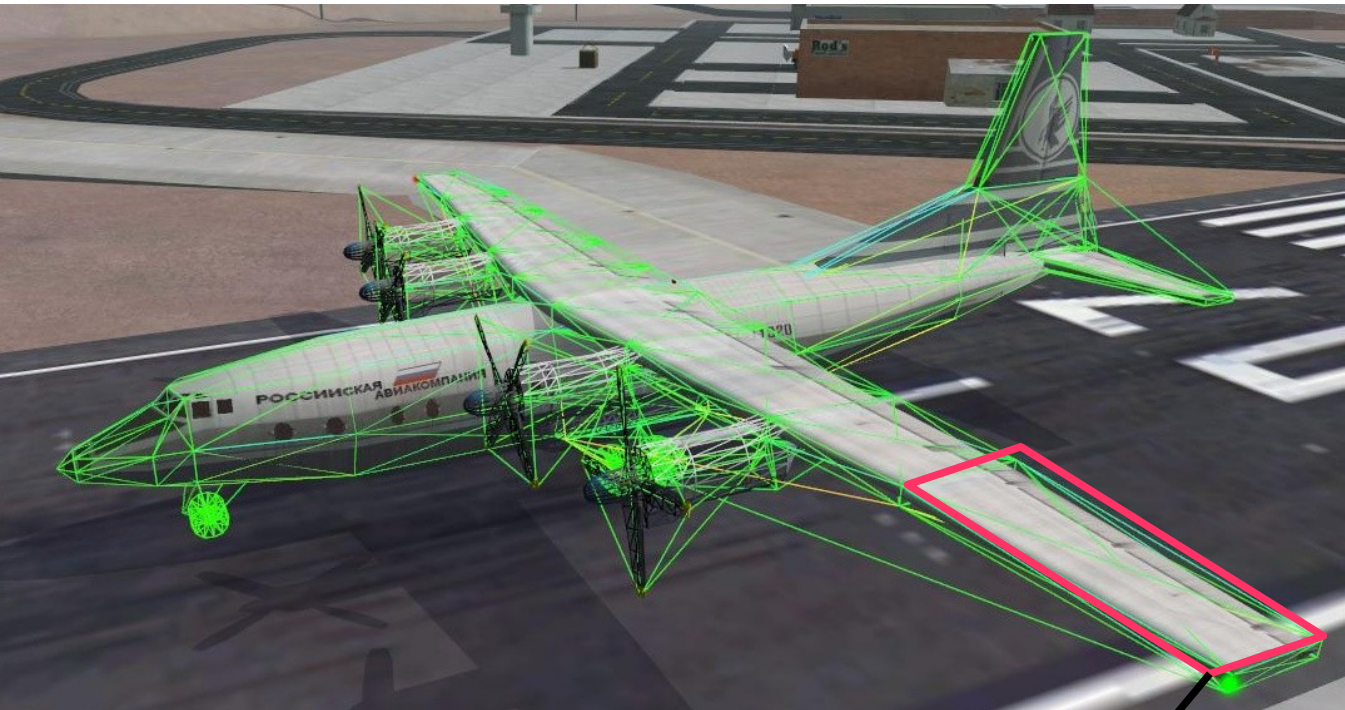


Aerodynamics

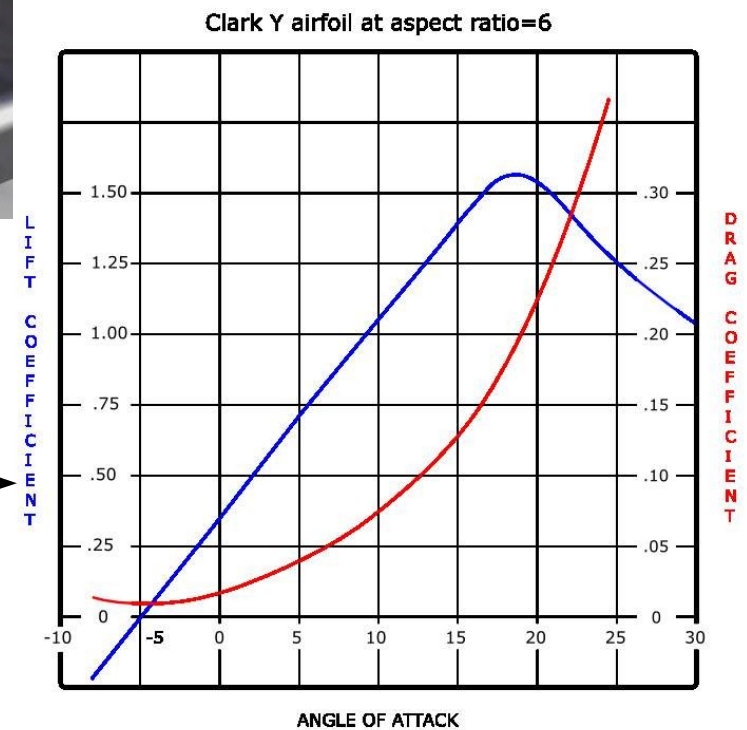
- Model type « *blade element theory* »
 - Similar to the simulator X-Plane
- Segments profiling wing (airfoil) are associated with nodes
 - The forces applied at these nodes resulting from polar profile depending on the angle of attack (lift, drag, torque)
- The flight behavior stems directly from the geometry of the device (including its deformations)



Aerodynamics



PSU 90-125WL



<http://www.youtube.com/watch?v=P3f3HYGN6tE>



Hydrostatic / Hydrodynamics

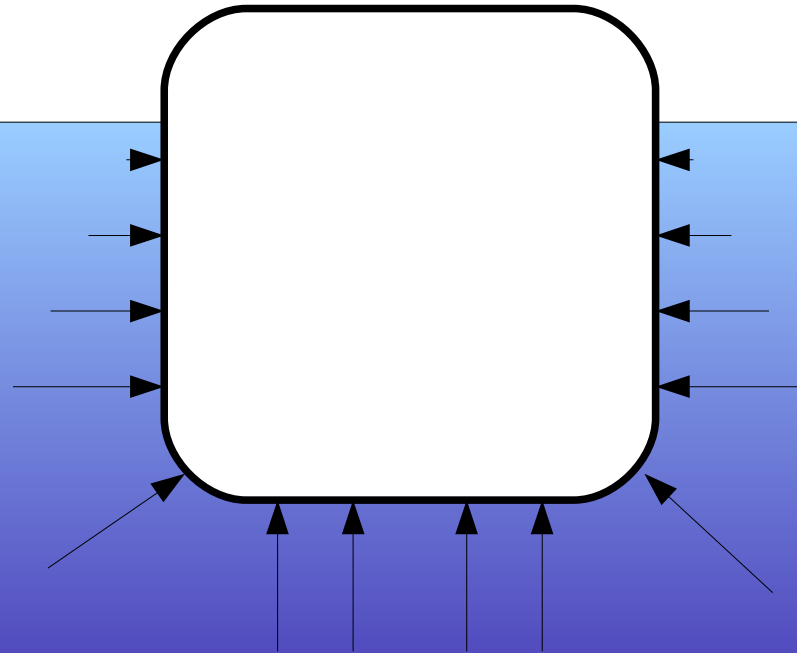
- Hydrostatic: applying a gradient pressure hull sealed
 - Only local law is coded, the comprehensive law (Archimedes) emerges from the simulation
 - Can model all kinds of hulls in wave fields
- Hydrodynamics: simplified model of lift and drag
 - No detailed model of the dynamics of the water body (too high computational complexity)



•Hydrostatic



<http://www.youtube.com/watch?v=4wWfTTU77dA>





Network play

- Each player simulates his vehicle
- The calculated coordinates of the nodes are distributed to other players
- limited physical interaction between players
- Centralized network architecture
- High bandwidth requirement, but DSL is sufficient (16 players max)
- Problems on the multithreaded server:
 - Sub-standard POSIX specification Thread
 - Inconsistency of the cancel calls in glibc



Network play





Tools

- Ogre 3D
- OpenAL (openal soft)
- Autres dépendances :
 - OIS
 - Lua
 - SocketW
 - Pthreads
 - wxWidgets
- More Tools : the Gimp, Cmake, SVN



Ogre3D

- Object-Oriented Graphics Rendering Engine
 - <http://www.ogre3d.org/>
- Licence LGPL
- Very good quality
 - Very well written code, object-oriented
 - Few bugs fixed quickly
 - Multi-platform (Backends OpenGL or DirectX)
 - Supports latest 3D technologies (shaders, volume shadows, etc.)
- Try it!





OpenAL

- Only free 3D audio library and multi-platform (2005)
- Problems:
 - Reference Implementation (Creative) buggy
 - Nonfunctional hardware acceleration with many sound cards
 - Fundamental problem in the API:
 - The number of sound sources is (very) limited, and this limit is not provided by the API
- Implementation currently used: OpenAL Soft
 - <http://kcat.strangesoft.net/openal.html>



Community



The power of the Internet

- No promotion
 - 1 blog
 - Google & recommendations :

RoR 0.35 (March 2008) :
200.000 downloads

RoR 0.36 (February 2009) :
83.000 downloads
(20.000 in 7 days)



PC Gamer UK 12/07



MicroSIM 06/08



Website

Official Rigs of Rods Forums
POWERED BY SIMPLE MACHINES

Welcome, Guest. Please login or register.
Login with username, password and session length

Forum Register Repository Help / Manual / Wiki Blog Chat (19 Users) Server List Bugtracker

NEWS: Bugtracker now supporting your forum account / please help us translating / we passed the 10k members mark with nearly 200k posts and 28 Million pageviews - thank you all for contributing!

Official Rigs of Rods Forums

General Rigs of Rods Chat

Board name	Topics/Posts	Last post
General Chat About Rigs Of Rods General discussion about Rigs Of Rods.	1142	Re: Problem with budriv... by dennis
Screenshots and movies Show us your RoR adventures!	14048	Today at
General Multiplayer Chat A place for people to chat about RoR online experiences. Child Boards: Group Chat	1127 16134 393 5444	Re: Your Day At Work! by Jacob1022 Today at Re: Chevy S10 Tuning Clu... by jakabecvar Today at

Support

Board name	Topics/Posts	Last post
Rigs of Rods Support - Major bugs only Found a big problem that prevents you from running Rigs of Rods, or other hardware issues? Ask about it in here. Child Boards: Linux support, MacOS support	281	Re: Can't start game if... by Dubs12
Rigs of Rods Support - Minor bugs and glitches Found a small, gameplay-related problem in Rigs of Rods? Ask about it in here. Child Boards: Linux support, MacOS Support	2087	Yesterday at
Rigs of Rods Support - Other Problems For all vehicle, skin, terrains and static object problems.	384 2090	Re: The Floating Orb by Buttanio June 18, 2009.
Rigs of Rods feature requests Post here your feature requests, and pray!	1196 9568	Windows Vista - bousdies... by YAMPIRE V12 Today at
Webservices Support support for all RoR web services Child Boards: Wiki Support, Forum Support, Repository Support	821 5572 521 3920	Re: "Anti"-Invisibility by wee jimmy mahits Yesterday at MOVED: Ubuntu Issue - Pa... by thomas Today at

Rigs of Rods Repository
POWERED BY SIMPLE MACHINES

Welcome, Guest. Please login or register.
Login with username, password and session length

Forum Repository Help / Manual / Wiki Blog Server List Bugtracker

Download Rigs of Rods (0.36.1) (for Windows)
(all official Downloads here)

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7 downloads running

Categories

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 - Top Downloads today
 - Top Downloads Last Week
 - Top Downloads This Month
 - Top downloaded
 - Top Rated Downloads
 - Most favorited
- All Files
 - Land Vehicle
 - Other (76)
 - Light Vehicle (52)
 - Street (168)
 - Racing (34)
 - Offroad (69)
 - Fantasy (6)
 - Robot (1)

Street / f250.zip (4.2 MB), Jun 19 2009
by matt6855 (view files by matt6855) [view mirrors](#)

its a 80s model f250
flexbody
custom sounds
thanks to corenzo111 for the body
and thanks for anybody else i have forgot

view details (you must login to rate files) (rating disabled) no ratings yet
favorited 0 times
Downloads: 93 today, 648 total

Street / 350z18ETA.zip (3.49 MB), Jun 19 2009
by Rockport19 (view files by Rockport19) [view mirrors](#)

Here is my Nissan 350z.
Why this car?
-this is the most sold sportscar in the world
-i like the design and the power of this car
-its a nice Tuner. Please mod this car!!
-it has the best V6 sound ever :)
-i dont like the new 370Z
Body:
-car was originally made for a performance test
-the Body of the car is highly detailed
-the submesh is handmade :)

Created and maintained by Thomas Fischer

- Forum, Repository, Wiki, Chat

Lighthttpd, mysql, PHP/fastcgi/xcache,

Memcached, rsync, SMF, mediawiki, ejabberd

Tools used:

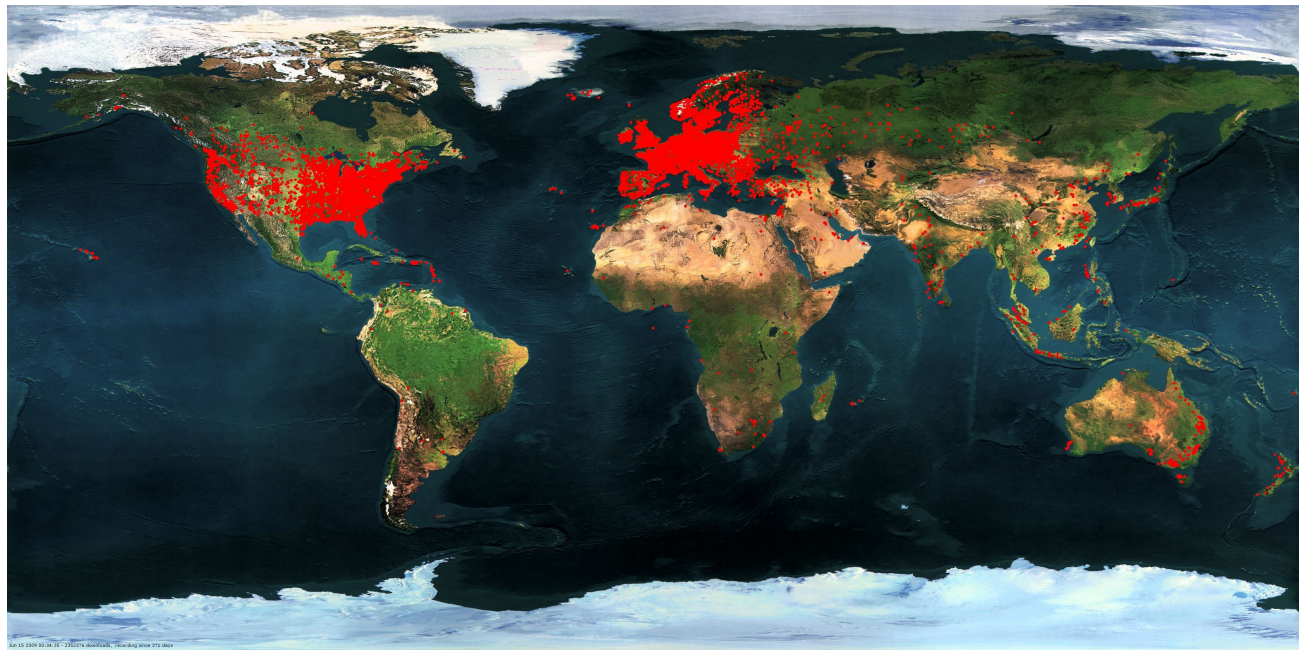
- Community translation <http://communitytranslate.org/>

- MonitorDataSink <http://code.google.com/p/monitordatasink/>



Community

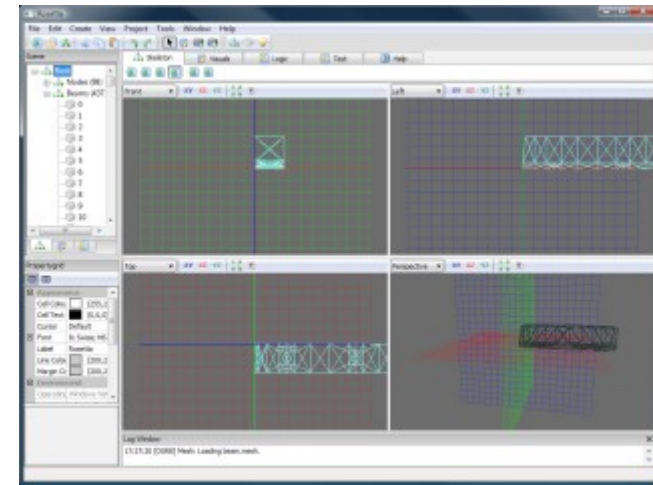
- Official site opened in November 2006
 - Forum
 - 13.295 members
 - 259.952 posts
 - 3M pageviews, 12,5M hits et 550 GB per month (November 2009)
 - Repository
 - 2.094 mods
 - 8 mirrors
 - 3 TB/month
 - SourceForge : 5-7 TB/month





The future of RoR

- The development model must change:
the project has become too complex
 - Tracking dependencies
 - Consistency of content
 - Testing and Validation
- We need you!
 - RoR NG
- Rethinking the future:
projet Rosetta (RoR2.0)





Beyond the game

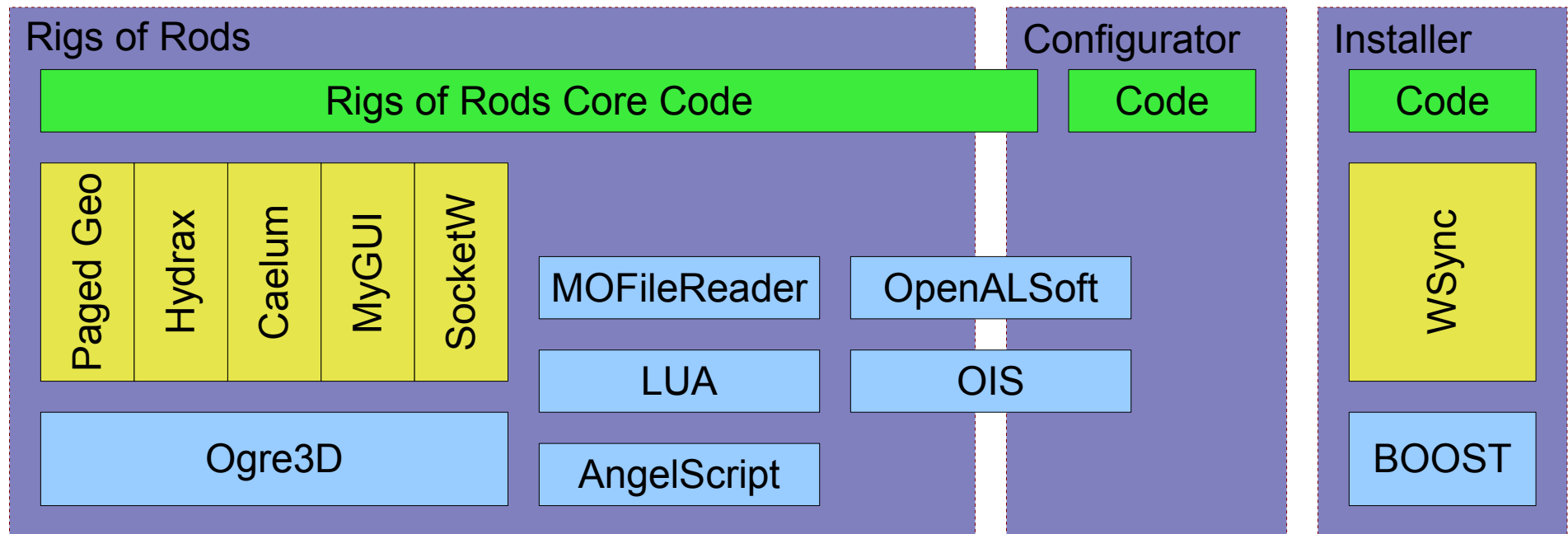
- **SafeDrive** (Hungary)
 - Security training for drivers of commercial vehicles
 - Force Platform Dynamics
 - Under development



- « We evaluated a wide range of simulation technologies and softwares. We contacted large software houses as well as the smallest ones. We have chosen RoR. »

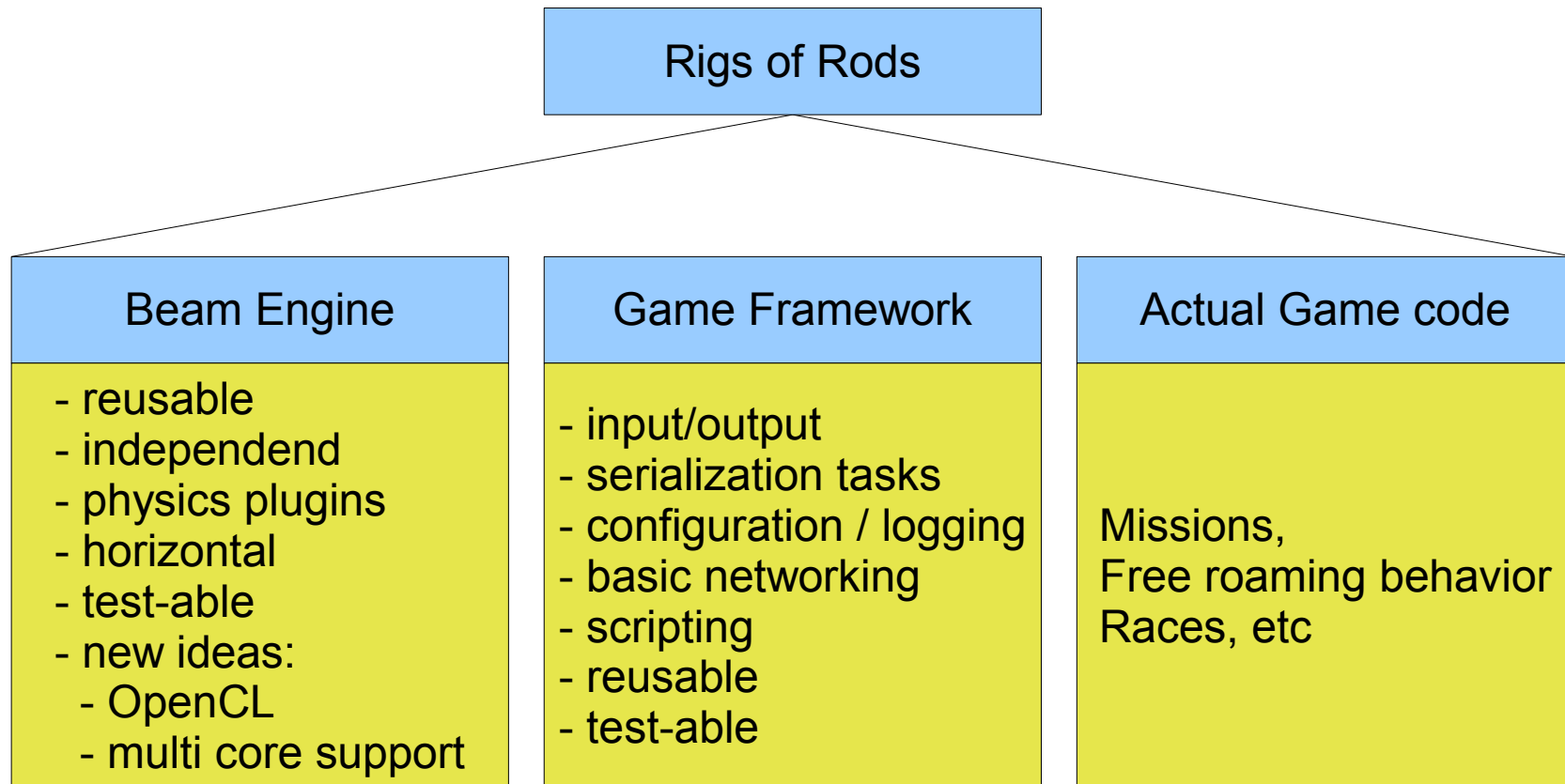


Architectural Overview





Architectural Goal





Contribution Areas

- Physics:
 - Improve a certain aspect of the engine:
 - i.e. Improve the flight model to support space flight
 - Improve the behavior of existing features:
 - i.e. Optimize the code that calculates buoyancy of nodes below water
 - Help with the new engine design:
 - Just started, open for all ideas :)



Contribution Areas

- Graphics:
 - Fix / improve eyecandy features (important)
 - Depth of Field
 - HDR
 - Parallel Split Shadow Maps
 - Hydrax Water Integration / Below Water GFX
 - Improve physics <---> GFX coupling:
 - Effect of shattering glass in slow-motion
 - Improve splashing effect of boat waves